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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,894	09/09/2003	Hieronymus Andriessen	224088	2642

23460 7590 03/20/2008
LEYDIG VOIT & MAYER, LTD
TWO PRUDENTIAL PLAZA, SUITE 4900
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EXAMINER

BARTON, JEFFREY THOMAS

ART UNIT	PAPER NUMBER
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1795

MAIL DATE	DELIVERY MODE
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03/20/2008

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/657,894	Applicant(s) ANDRIESSEN ET AL.	
	Examiner Jeffrey T. Barton	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period **will** apply and **will** expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply **will**, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 January 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-14 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-14 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>20080102</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 02 January 2008 has been entered.

Response to Amendment

2. The amendment filed on 02 January 2008 does not place the application in condition for allowance.

Status of Rejections Pending Since the Office Action of 03 July 2007

3. All rejections are maintained.

Claim Objections

4. Claim 8 is objected to because it abruptly ends, apparently in the middle of an intended limitation. The claim ends, " . . . ; and said 1,3,5-tris-aminophenyl-benzene compound." As this provides no explicit further limitation, the claim is treated herein as though this recitation were not present. Appropriate correction is required.

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Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Van der Auweraer et al (J. Phys. Chem.

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1993, 97, 8808-8811). Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 2, 7, 8, 9, and 14.

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Van der Auweraer et al teach the hole transport abilities of amorphous layers of 5'-[4-[Bis-(4-ethylphenyl)amino]phenyl]-N,N,N',N'-tetrakis-(4-ethylphenyl)-1,1':3',1"-terphenyl-4',4"-diamine, which corresponds to the structure given in claims 1, 7, 8, and 14, and the first listed compound in claims 2 and 9. This compound is shown to have comparable or superior hole mobility to other known hole transport materials. (Table I)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with the compound taught by Van der Auweraer et al, because Van de Auweraer et al teach its comparable or superior hole mobility to other known hole transport materials. The selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in "stable cationic form" in claims 1-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. Van der Auweraer speaks of a "one electron oxidation-reduction process" (Introduction, 1st paragraph) associated with hole or electron transport, and a more thorough description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444, "Triarylamine as Functional Moiety" section) This section of Thelakkat describes the triarylamine unit's "ability to transport positive charge centers via the radical cation species". Since hole transport in triarylamine compounds is clearly associated with a

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cyclic oxidation/reduction process involving a cationic radical species, it is the examiner's position that the cationic form of the hole transport material taught by Van der Auweraer will inherently be present in the device taught by this combination. It is the Examiner's further position that the transient nature of this cationic species does not imply that the species is necessarily not stable. There is no evident structural difference between the instant cations and those inherently provided in the prior art, and the properties of the cations are therefore considered to be the same.

9. Claims 1, 3-8, and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Shirota. (J. Mater. Chem., 2000, 10, 1-25) Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

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Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 7, 8, and 14.

Shirota teaches the hole transport abilities of amorphous TDAPB and *o*-, *m*-, and *p*-MTDAPB, which correspond to the structure given in claims 1, 7, 8, and 14. (Structures on page 4, partial mobility data in Table 3) This compound is shown to have comparable hole mobility to other known hole transport materials. (Table 3) In addition, Shirota teaches the usefulness of these organic hole transport materials in photovoltaic cells, including photoelectrochemical cells, such as those taught by Graetzel. (Introduction, Organic photovoltaic devices sections)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with TDAPB, *o*-, *m*-, or *p*-MTDAPB as taught by Shirota, because Shirota teach its

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effectiveness in hole transport and suggests the usefulness of this class of compounds in providing hole transport in photoelectrochemical cells. (Introduction, Organic photovoltaic devices sections) The selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in “stable cationic form” in claims 1 and 3-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. A description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444, “Triarylamine as Functional Moiety” section) This section of Thelakkat describes the triarylamine unit’s “ability to transport positive charge centers via the radical cation species”. Since hole transport in triarylamine compounds is associated with a cyclic oxidation/reduction process involving a cationic radical species, it is the examiner’s position that the cationic form of the hole transport material taught by Shirota will inherently be present in the device taught by this combination. It is the Examiner’s further position that the transient nature of this cationic species does not imply that the species is necessarily not stable. There is no evident structural difference between the instant cations and those inherently provided in the prior art, and the properties of the cations are therefore considered to be the same.

Response to Arguments

10. Applicant's arguments filed 02 January 2008 have been fully considered but they are not persuasive.

Applicant argues that the hole-transport compounds of Van der Auweraer and Shirota are non-ionized compounds, which would not be inherently ionic. The Examiner agrees. However, in the process of hole conduction, holes must inherently be present within molecules of the compound. Since the hole is the absence of an electron from a material, this must inherently impart a positive charge to the molecule. The presence of a hole in a molecule of the hole transport material taught by Van der Auweraer will inherently provide that molecule with a cationic charge. It is the Examiner's position that the transient nature of this cationic species does not imply that the species is necessarily not stable. There is no evident structural difference between the instant cations and those inherently provided by the presence of holes in the hole conducting materials of the prior art, and the properties of the cations are therefore considered to be the same.

Applicant argues that the selection of a particular compound for use in solid state photoelectric devices is nothing more than guesswork, in the absence of motivation for Graetzel et al. This is not persuasive because Van der Auweraer and Shirota clearly disclose that the respective materials are effective hole transport compounds. The selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) Furthermore, Graetzel et al clearly envision

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selection of known hole transport materials, including reversibly oxidizable organic compounds, such as that taught by Van der Auweraer et al. (Graetzel et al, paragraph 0012) The motivations for the combinations are clear. As the reasons for combination are thus clearly provided by the references, Applicant's allegation of hindsight reconstruction is unsupported.

Applicant's contention of surprising, or unexpected results is not supported by the cited portion of the specification. Support for the limitations of the claims as amended is found at pages 4-5 of the specification, but there is no data provided that demonstrates anything unexpected.

Applicant's arguments concerning the expected inoperability of the hole transport materials of Van der Auweraer and Shirota if they were cationic are not persuasive because the rejections do not require modification of the material to a permanent cationic form as implied in the remarks.

Conclusion

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Jeffrey T. Barton whose telephone number is (571)272-1307. The examiner can normally be reached on M-F 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Nam X Nguyen/
Supervisory Patent Examiner, Art
Unit 1753

JTB
14 March 2008